

JACKSON STATE FOREST
PILOT STUDY IN STREAM CLEARANCE
1952 - 1959

Jean E. Sindel



State of California
Department of Natural Resources
Division of Forestry
1960

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Cover Picture: Typical log jam on West Chamberlain
Creek, Jackson State Forest, November 15, 1955.

California Division of Forestry
Sacramento, California
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Increasing population pressures in California are having a tremendous impact upon wild land use and resources of the State. Timber-producing lands and related resources of water and wild life, including fish, are vitally affected by the degree and nature of wild land use. As use of these resources increases, their values become higher, and more intensive land management practices become practical and necessary.

Soil is as basic to the growing of timber as the right kind of water and stream conditions are to maintaining desirable species of fish life. Research has emphasized the importance of the type and depth of soil for optimum production of timber as a crop. Intensive forest management requires practices during logging which will protect productive timber soils from excessive erosion such as washing and sliding, particularly during logging. Some of the timber management practices which are carried out to maintain soil values also have beneficial effects on stream flow as it affects fish life. Conversely, some practices for maintaining desirable fish life assist in protecting forest soil values. This occurs through preventing excessive backing up of water and under-cutting, with consequent slides and flooding, and resultant soil losses.

The increased value of salmon and steelhead both to the sportsman for recreation and as a food source requires some practices for maintenance of this fish resource where harvesting of timber crops over extensive areas may cause unfavorable stream conditions for reproduction of these fish species. This has been recognized by the California Legislature through its passage of legislation aimed at insuring stream conditions which will allow salmon and steelhead to pass upstream to spawn, and to further maintain stream conditions which are favorable to the reproduction and growth of these fish.

Stream clearance in the form of prevention and removal of logging debris has become an important aspect of many logging operations in California in the last few years. In California, according to Section 5948 Fish and Game Code, it is unlawful to create or permit to exist any log jam or debris accumulation in any stream which will prevent the passing of fish up and down stream, or which is deleterious to fish life. This law, which was originally passed in 1951 (Section 482.5 Fish and Game Code) to protect the passage of the anadromous salmon and steelhead, applied only to Del Norte, Siskiyou, Trinity, Humboldt, Mendocino, Sonoma, and Marin counties. Because it was difficult to interpret and administer this section of law, specific standards as to what constituted an acceptable degree of stream clearance in the case of logging jams and other logging debris were enacted as Section 755, Title 14,

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Division 1, Chapter 1, Article 5 of the Administrative Code in December of 1954. Fish and Game laws relative to pollution and stream barriers can be found at the end of this report. In 1957, Section 482.5 of the Fish and Game Code was amended and codified to its present form to apply to any species of fish in any stream in the State. Therefore, it is imperative that the logger prevent pollution and putting debris in streams and that he remove from the stream any debris accumulation resulting from his logging operations.

PILOT STUDY

Late in 1955 the Department of Fish and Game brought to the attention of the Division of Forestry serious logging debris accumulations along 2 miles of stream on West Chamberlain Creek in the eastern part of the Jackson State Forest. This area had been logged largely by the Caspar Lumber Company before the Jackson Forest was acquired by the State except for some 1500 feet of stream within the 1952 State timber sale area (fig. 1). A survey of this two miles of stream was made in December of 1955. It was estimated that some 103,000 cubic feet of logging debris in the form of logs, chunks, slabs, limbs, and bark had collected in or near the stream. Most of this material had been deposited into 15 large bunches or log jams through the influence of natural causes following logging (cover). The degree to which these accumulations hindered the passage of fish was debatable. Five of the log jams were located within the 1952 State timber sale area where special effort had been made following logging to open the stream with a D-8 bulldozer. Some 2,000 cubic feet of logging debris had been removed from the stream prior to the survey described above.

A study of stream clearance was initiated on Jackson State Forest in 1956 in cooperation with the Department of Fish and Game. The purpose of the study was to explore and evaluate methods of opening blocked streams and keeping streams clear of logging, slash, and debris. Low cost stream clearance methods were sought.

The Jackson State Forest is a 52,042 acre experimental and demonstration forest located between Fort Bragg and Willits in Mendocino County. It is managed and administered by the California Division of Forestry. The property was acquired by the State from the Caspar Lumber Company during the period 1947 - 1955. At the time of acquisition the forest was largely cutover except for some 10,000 acres of old growth located in the eastern portion of the forest. The Division of Forestry began making timber sales on this forest in 1952 in the old growth redwood-Douglas fir stands in West Chamberlain Creek adjacent to cutover areas logged by the previous owner.

The trees and logs in this area are large. The heavy vegetation is typical of southern redwood stands. A considerable number of trees and logs are not suited for economical manufacturing processes due to roughness and defect. Logging under these conditions results in a large amount of cull logs, logging slash and debris left in cutover areas. The situation is further complicated in that the largest trees and heaviest stands of timber occur in the bottoms of narrow, steep-sided canyons.

The ground is steep to precipitous and the gulches and stream courses are narrow. Heavy equipment is required for logging and much material is knocked down or pushed over in the process of removing the large merchantable logs. Due to the steep ground and heavy equipment which must be used much of the unused material left in the woods tends to work its way downhill and into the water courses.

The climate is characterized by distinct wet and dry seasons. Rainfall as high as 80 inches per year is not uncommon. Although annual rainfall fluctuates widely from "normal." Ninety percent of the precipitation falls during the months of October through March (table 1). Some 60 percent of the rainfall usually comes during the three winter months of December, January and February, often in storms of heavy intensity for several days.

All the foregoing factors contribute to the movement of earth and debris. Keeping debris and slash out of stream beds is a problem of considerable magnitude.

Debris Removal in Winter

In December of 1955 a 3-man Conservation Camp Crew* was assigned to a stream clearance project in the West Chamberlain Creek drainage. This crew worked with a D-7 bulldozer in an attempt to remove one or more of the large log jams in West Chamberlain Creek. This crew tried to skid the jammed logs to higher ground. It was found that this method would not work in winter due to the depth of water in the creek and to the wet and slippery condition of the soil. The tractor was unable to get firm footing or traction and it was practically impossible to get rigging lines on the logs in the stream because of the depth of the water. This trial was continued for three days and a small volume of material was removed from the stream and piled (figs. 2 and 3). The work was stopped because of the obvious impracticality of fighting the inclement weather, damage to roads, high water, and boggy slippery ground. Burning accumulations in place also was unsuccessful as the fires went out in the wet material before much good was accomplished.

Stream-driving of Debris

The impracticality of attempting stream clearance work during wet winter weather, and the position of the partially buried chunks and logs in many of the log jams required some new approaches. An attempt was made to break up the log jams by sawing key logs into shorter lengths (fig. 4). It was hoped that this would cause the debris to float out in the high water in the winter. Two log jams near the road were left as booms to catch and hold the material that had been bucked into short lengths further upstream (fig. 5). The plan was to "stream-drive" the short material into these catch booms and then remove it with a crane or other mechanical device or try to burn the debris in place. In other words the debris was to be concentrated in two places by

* This is a crew of State prison inmates from Parlin Fork Conservation Camp. About 20 of these Conservation Camps with a year-round population of from 60 to 100 inmates each are maintained cooperatively by the California Division of Forestry and the California Department of Corrections. These men work on many types of conservation activities and are used extensively in the control of wild fires in California. About 10 to 15 men usually comprise a crew. Each crew is supervised by a permanent civil service foreman employed by the Division of Forestry

Table 1. Monthly rainfall record for Parlin Fork, Jackson State Forest, 1951 - 1959

Year	Rainfall in inches												Totals	
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Calendar Year	Seasonal
1951	.....	.....	.....	....	....	....	.00	.03	.31	4.39	10.90	21.85	.....	.....
1952	15.14	8.30	6.46	2.60	0.87	1.70	.00	.05	.13	.23	5.69	22.24	63.41	72.55
1953	18.89	1.29	6.54	5.50	3.42	1.53	.00	.40	.50	2.73	9.64	4.74	55.18	65.51
1954	13.81	8.48	12.42	1.76	.00	1.67	.00	.00	2.24	2.37	8.64	10.64	62.06	56.15
1955	5.23	2.72	1.67	6.33	.00	.00	.00	.00	.77	1.56	9.43	22.64	50.35	39.87
1956	18.87	9.26	1.59	.70	1.10	.41	.00	.00	.00	6.48	.37	1.97	40.75	66.33
1957	7.54	8.36	9.60	2.72	5.97	.01	.04	.00	2.68	10.44	5.06	9.16	61.58	43.02
1958	10.68	24.37	14.96	.22	.84	1.33	.00	.00	.21	.95	3.62	3.72	60.90	79.78
1959	16.86	9.25	3.91	.56	.28	.04	.00	.04	2.86	.72	.15	3.38	38.05	39.40
Monthly Average	13.38	9.00	7.14	2.55	1.56	.84	T	.06	1.08	3.32	5.94	11.15	54.04	57.71
Percent by month	24	16	13	4	3	1	0	0	2	6	11	20	.....	.....



Figs. 2 and 3. Logs and trash were removed from a short section of West Chamberlain Creek during December 1955. A D-7 bulldozer equipped with a logging winch was used in removing these few logs. (Fish and Game photos).

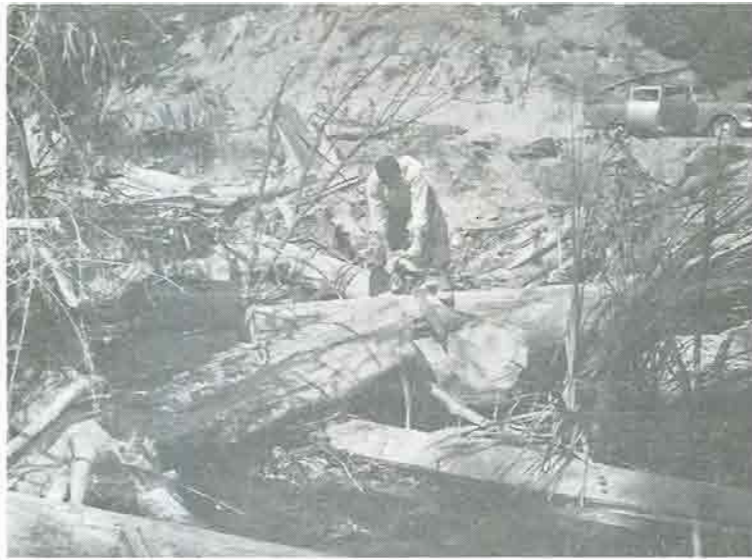


Fig. 4. Bucking logs in West Chamberlain Creek.
(Fish and Game photo) 1956.



Fig. 5. Log jam left to act as a boom, West Chamberlain
Creek. (Fish and Game photo). 1956.

high water and then removed or burned. During the late summer and fall of 1956 Conservation Camp Crews were assigned to this work in West Chamberlain Creek.

The results of this experiment were poor because of brief peak flows in the stream and lack of a sustained volume of high water. There was not enough rainfall to raise the water level in the creek sufficiently to float the sawed material during the winter of 1956-57, nor has there been since.

Debris Removal in Summer

Immediately upstream in West Chamberlain Creek, additional cleanup was started during the summer of 1956. The bulk of the effort was concentrated in that portion of the stream lying within the 1952 and 1953 State timber sale areas. This effort consisted of hand piling the small material using Conservation Camp Crews and skidding large logs with a HD-5 bulldozer (figs. 6 and 7). Attempts were made to remove or burn the woody material which could float and form barriers. These areas had been logged by private contractors in accordance with a Division of Forestry timber sale agreement. The stream had been bulldozed open at the completion of the 1952 timber sale. A D-8 bulldozer was used and the stream channel was opened by pushing all debris aside. During the winters following this work, high water and erosion redeposited practically all the material originally moved aside into the stream bed in large log jams (fig. 8). This indicates that floatable material must not only be removed from the stream bed proper but must also be moved far enough to preclude the possibility of the debris rolling back into the stream or being refloated. Sufficient area for decking and disposal may not be available in these steep-sided narrow canyon bottoms. It is also difficult to gauge the extent of winter maximum peak flow during the summer period of low water when the work must be done. It was found to be impractical to attempt to destroy this material with fire during the dry summer months because of the extreme fire hazard in the surrounding areas. The material in the streams was bucked and removed once more from the stream by power equipment or hand piled and then burned during the winter months (figs. 9 and 10). The stream was physically cleared of all debris and the channel was left open. About 0.4 mile of stream was cleared in this manner.

After one wet season a few minor collections of debris formed. This new material was unearthed by winter rains or slight changes in stream channels which freed this debris to float downstream (figs. 11 and 12). Other new material rolled into the stream from one cause or another. These new accumulations although not serious were discouraging, considering the previous effort expended to clear the stream (figs. 13 and 14).

Cost of Corrective Work

Stream clearance work was found to be extremely costly in manpower and equipment (table 2). The costs include all effort to buck logs and chunks in preparation for the attempted stream-drive and also the effort made in mechanical removal and hand piling along two miles of stream on West Chamberlain Creek. Conservation Camp labor with Division of Forestry supervision and equipment were used.



Fig 6. Tractor skidding log too large to handle by hand. West Chamberlain Creek. (Fish and Game photo) 1956.



Fig. 7. Piles of debris ready for burning in foreground. Logs in background were salvaged or burned. West Chamberlain Creek. (Fish and Game photo) 1956.



Fig. 8. Logging debris redeposited in stream after logger and Division had cleaned the stream following logging. (Fish and Game photo).

Beaver Dams

Another facet of the stream clearance problem in this area was the occurrence of beaver dams. Two beaver dams obstructed the passage of fish (figs. 15 and 16). The beaver were introduced in 1941. Department of Fish and Game trappers removed 13 beaver from this immediate area during the fall of 1956. The dams were destroyed along with the regular cleanup work.

Action Taken on Timber Sales

A map on page 3 shows the areas logged under the Jackson State Forest timber sale program discussed in this report. On State timber sales beginning in 1952 careful control was exercised in regard to road layouts, landing locations, prevention of any deliberate felling of trees and tops into creeks and the pushing of material into streams. Intensive utilization specifications and two stage felling were prescribed to reduce the amount of logging debris. Specific clauses in the timber sale agreement made erosion control work on truck roads and skid trails mandatory, and



Figs. 9 and 10. Stream being cleared of debris at old log landing, West Chamberlain Creek. (Fish and Game photos) 1956.



Fig. 11. This area was cleared by hand and by tractor for the larger material. The debris in the stream bottom was uncovered by high water or refloats. One winter has passed since the original stream clearance work was done. (Fish and Game photo) November, 1957.



Fig. 12. Accumulation of debris redeposited in West Chamberlain Creek following the 1956 clearing project. (Fish and Game photo) 1957.



Figs. 13 and 14. Condition of stream bed in 1959, 3 years after initial work by Conservation Camp crews.

Division inspection on the ground was made to insure compliance with these provisions of the contract. Despite these efforts a large amount of debris accumulated along the creek bottom in the 1952 and 1953 timber sale areas. This occurred because of the large volume of timber cut and the steep slopes bordering the creek. Heavy rains during the 1955-56 winter redeposited material which had previously been removed from the stream and brought additional material down the slopes and into the bottom of the creek. This material was then bunched into several jams by the downstream rush of water.

Table 2. Labor and equipment-use for stream clearance pilot study, West Chamberlain Creek, December 1955 to December 1956.

	Labor (man-hours)	Equipment-use	
		miles	hours
Foreman, CDF	481	.....	.....
Equipment operator, CDF	27	.....	.....
Conservation camp inmates	3,762	.....	.....
Trucks, stakeside	.....	1,020	.....
Truck, dump	.....	196	.....
Pickup	.....	93	.....
Chainsaw	.....	.....	355
Bulldozer (HD-5)	.....	.....	57
Bulldozer (D-7)	.....	.....	57
Totals	4,270	2,309	469

The 1954 and 1955 logging operations took place in gulches tributary to Chamberlain Creek and the stream headwaters too high to be of concern for fish life.

In the summer of 1956, special effort was made on the State timber sale to leave 0.7 mile of stream bed on main Chamberlain Creek free of debris. On this sale the purchaser was advised that the stream was to be left open and that any accumulations of logging debris were to be removed from the stream. Upon completion of the logging, the purchaser assigned a D-8 bulldozer and one man to do cleanup work (fig. 17). Four days were spent dragging debris completely out of the creek bottom. In one area, a new stream channel was constructed because it was impractical to remove the logging debris (fig. 18). The total effort taken by the purchaser to accomplish this cleanup work was:

Hours	
Bulldozer D-8	35
Choker setter	70
Supervision	16



Figs. 15 and 16. Beaver dam in West Chamberlain Creek, prior to destruction in 1956 (upper photo) and one year later (lower photo). (Fish and Game photos.)



Fig. 17. Portion of main Chamberlain Creek channel as it looked in October 1956 after cleanup by timber sale purchaser. (Fish and Game photo).



Fig. 18. Debris pushed from stream bed leaving channel free of debris, Chamberlain Creek. (Fish and Game photo) 1956.

After going through one rainy season, several small accumulations occurred as a result of smaller material catching and piling up (figs. 19 and 20). However, these did not block the stream to the passage of fish. By and large, this portion of the stream has remained open as the logger left it.

According to timber sale agreement, the State is responsible for burning accumulated slash in and around landings. Log landings on State timber sales usually lie close to the stream. An attempt is made to construct landings to provide sufficient room to accommodate logging debris and not push this debris into the streams. This practice is not possible in all locations as the rough nature of the terrain may limit suitable space above high water.

Debris at the landings in the 1956 sale area was burned immediately following the first heavy rains. This eliminated much debris which could have drifted downhill into the stream. In one case, however, a slip developed immediately under the landing (figs. 21 and 22). It is not known how much the burning contributed to this earth movement. At any rate, a considerable volume of earth and debris slid down and dammed the creek. An attempt was made to remove this barrier by hand and also with dynamite. The dam that first resulted was lowered sufficiently to allow for the passage of fish.

In 1957 part of the timber sale area was located in another drainage near the divide between the Big River and the Noyo River watersheds. At the time of sale and prior to any cutting in this gulch, this small creek was just a trickle of water. However, a few small fish were observed in the stream at the lower end of the sale area prior to logging. The quantity of water in this small stream increased throughout the summer and late fall as the logging progressed. The interesting point to be noted here is that the area now has a stream that will produce a larger volume of water and more of the stream can be used by fish for spawning. This is pointed out as a matter of interest and information to emphasize that a small stream may become more important after cutting and require protection.

The 1958 timber sales on Jackson State Forest were not located in areas involving significant portions of spawning streams.

In 1959 one of the sale areas included about two miles along James Creek, a main tributary to the North Fork of Big River, which carries enough water to be significant for fish production. This area was being logged during the preparation of this report.

Provision in State timber sale agreements since 1956 have required compliance with laws regarding pollution as well as debris and barriers in streams. Other requirements designed to result in a clear stream bed after logging have been emphasized to potential bidders during advertisement of the sales. Generally a reasonably good "leave" of small trees with low present market value and good chances for survival and future growth is being left in gulches. This is resulting in fairly adequate shade and protection to stream banks. Beginning in 1957, a fixed amount per thousand board feet has been allowed in timber sale appraisals to provide for the cost of stream clearance. Special effort has been made in recent sales to leave more trees in gulches and keep roads farther from streams where this is possible.



Fig. 19. West Chamberlain Creek in the fall of 1956 after the logger had cleaned the stream. (Fish and Game photo).

Fig. 20. The same scene one year later. Gravel has been deposited and two small jams are starting to form. (Fish and Game photo) 1957.





Fig. 21. Bark accumulation on lower side of log landing in 1956 sale area ranges from 5 to 20 feet deep and extends from road to creek bottom. (Fish and Game photo).



Fig. 22. Same scene one year later, 1957; bark has been burned and area cleared by use of fire. Note evidence of small landslip from road to creek. (Fish and Game photo).

Exploratory studies of stream clearance methods on Jackson State Forest bear out one strong conclusion. Preventive practices during logging, and follow-up work before equipment leaves the woods is both significantly cheaper and more effective than is post-logging cleanup. Prevention practices during logging are aimed at keeping as much objectionable debris as possible out of the stream bed.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations were indicated from the study made so far of stream clearance on Jackson State Forest:

1. Preventive effort, such as proper location of logging roads and skid trails, care to keep as much debris as possible out of stream beds, together with removal of debris concurrently with, or immediately following logging, is far cheaper and more effective than logging with no attention to prevention, and then attempting to do a complete clean-up job at some later time following logging.
2. In removal of established jams and debris:
 - a. Sawing key jam logs into short pieces so debris will float out in water may have possibilities in streams large enough to carry a sustained volume of high water, but this is not effective in short gulches having brief run-off peak flow.
 - b. Mechanical removal with a bulldozer augmented by hand labor is effective, but slow and costly. It may be the only solution possible in some cases. Where mechanical removal is necessary, some type of crane or loading equipment alone or in conjunction with a tractor and winch is almost essential to keep man hours as low as possible. A certain amount of cutting with power saws is also usually required. Such sawing was hard on the chains because of dirt and water. The use of hand saws proved to be impractical.
3. Material removed from the stream bed must be placed where it will not roll back into the stream or be refloated by high water. Burning log jams in place was unsuccessful and hazardous. Burning was a satisfactory method of disposal, however, where it could be done safely and when the material was piled by hand above the stream. Dynamite was ineffective in breaking the jams because of the nature of the jams and inability to confine the explosive force.
4. Any practice leading to leaving streams open after logging represents an additional logging cost.

5. The studies made so far have shown the need for continued investigation and further trials to obtain results which are acceptable at costs held to a practical level.

Where attention is given to prevention of stream blockage, and clearance work is done concurrently with or immediately following logging, we observe what appears to be the best method to keep stream beds clear. So far it appears to be the method giving the most return for minimum expense. However, this method must be recognized as another logging cost, either discounted from the stumpage, or as additional cost to the operator.

SUMMARY

The first attempts at stream clearance during wet weather in December 1955 were unsuccessful. The work was impractical, due to high water and wet ground.

The portion of the stream where key logs were sawed into short lengths in a "stream-drive" experiment on West Chamberlain Creek has not shown any significant results. This stream has had an insufficient sustained volume of high water since 1955 to float the debris downstream or into catch booms.

The stretch of stream where mechanical removal and burning was tried in West Chamberlain Creek has not shown any significant changes since clearing. The mechanical removal was effective, and still showed good results in June of 1959, after three winters. However, a prodigious number of man hours and equipment-use was necessary.

The 1956 timber sale area on the main Chamberlain Creek where stream clearance was done concurrently with logging has been successful to date. Three winters have left this area without major alteration of favorable stream conditions. There has been some slight floatation of small material into the channel.

More favorable results were achieved with much less expenditure of man and equipment hours on timber sale areas where preventative measures were taken during logging than on old cutover areas where preventive effort was not made.

The most definite recommendation that can be made is that preventive practices to keep as much debris as possible out of streams, together with concurrent or immediate post logging removal of debris, is much cheaper and more effective than logging with no attention to prevention and then large scale debris removal at some later time.

LAWS AND REGULATIONS ON STREAM POLLUTION AND OBSTRUCTIONS

(Compiled from the California Fish and Game Code and Administrative Code, January 1, 1958,
by the Department of Fish and Game, 722 Capitol Avenue, Sacramento 14, California)

CALIFORNIA FISH AND GAME CODE LAWS

As adapted by the California Legislature

Chapter 2. Pollution

Article 1. General

5650. It is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of this State any of the following:

- (a) Any petroleum, acid, coal or oil tar, lampblack, aniline, asphalt, bitumen, or residuary product of petroleum, or carbonaceous material or substance.
- (b) Any refuse, liquid or solid, from any refinery, gas house, tannery, distillery, chemical works, mill or factory of any kind.
- (c) Any sawdust, shavings, slabs, edgings.
- (d) Any factory refuse, lime, or slag.
- (e) Any cocculus indicus.
- (f) Any substance or material deleterious to fish, plant life, or bird life.

5651. Whenever it is determined by the department that a continuing and chronic condition of pollution exists, the department shall report such condition to the appropriate regional water pollution control board, and shall cooperate with and act through such board in obtaining correction in accordance with any laws administered by such board for control of practices for sewage and industrial waste disposal.

Chapter 3

Article 2. Dams and Obstructions

5948. No person shall cause or having caused, permit to exist any log jam or debris accumulation or any other artificial barrier, except a dam for the storage or diversion of water, public bridges and approaches thereto, groins, jetties, seawalls, breakwaters, bulkheads, wharves and piers permitted by law, and debris from mining operations, in any stream in this State, which will prevent the passing of fish up and down stream or which is deleterious to fish as determined by the commission, subject to review by the courts. (Amended by Stats. 1957, Ch. 2039.)

12015. In addition to any other penalty provided, anyone convicted of unlawfully polluting, contaminating, or obstructing waters to the detriment of fish life in such waters, shall either be required to remove any substance placed in the waters, which can be removed, that caused the prohibited condition or to pay the costs of such removal by the department. (Added by Stats. 1957, Ch. 2039.)

CALIFORNIA FISH AND GAME COMMISSION

Orders, Rules and Regulations

(Title 14, California Administrative Code)

755. Screens, Artificial Barriers. Pursuant to the provisions of Section 5948 of the Fish and Game Code, the following shall constitute a log jam or debris accumulation or other artificial barrier preventing the passage of fish up and downstream or which is deleterious to fish:

- (a) Any log jam or debris accumulation which has no well-defined channel through which all fish may pass upstream or downstream at any time without delay;
- (b) Any log jam or debris accumulation in any stream which reduces the dissolved oxygen content below five parts of oxygen to one million parts of water, or causes any other condition toxic to fish or aquatic life.